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WHITE FIR

. . . an American wood

Six species of the true firs in North America and two varieties of these species are generally referred to as "white fir" in the lumber trade. Their wood is light in weight, and is manufactured primarily into lumber, pulpwood, and plywood for construction and industrial uses. Construction uses include framing, sheathing, concrete forms, roof decking, trim, and millwork. Industrial uses include box and casket shook, pallet stock, dunnage, and laminated wood products.

AGRICULTURE
CURRENT SERIAL RECORDS

FS-237
March 1975
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F-506559

Figure 1.—The range of white fir *(Abies concolor)*.

COVER: White fir. F-508933

WHITE FIR

. . . *an American wood*

(*Abies* Mill.)

Donald C. Markstrom[1] and John R. Jones[2]

COMMERCIAL SPECIES AND NAMES

North American species of the genus *Abies* are often called true firs to differentiate them from Douglas-fir of the genus *Pseudotsuga*. There are six commercial species of true firs in western North America: two of these species have a commercial variety. Because the properties of all of these are similar, they are grouped in the lumber trade under "white fir," the common name of the most important commercial species, *Abies concolor*. In this leaflet, "white fir" is shown within quotation marks whenever this entire group is meant.

The following list shows this "white fir" group. The common name is used when an individual species is discussed in this leaflet.

Botanical name	Common name	Other names
Abies amabilis	Pacific silver fir	larch red fir silver fir white fir
A. concolor	white fir	balsam fir silver fir white balsam
A. grandis	grand fir	balsam fir lowland fir silver fir white fir yellow fir
A. lasiocarpa	subalpine fir	alpine fir balsam white fir
A. lasiocarpa var. *arizonica*	corkbark fir	Arizona fir cork fir white fir
A. magnifica	California red fir	golden fir red fir silver tip white fir
A. magnifica var. *shastensis*	Shasta red fir	California red fir golden fir red fir silver tip white fir
A. procera	noble fir	larch red fir white fir

DISTRIBUTION AND GROWTH CHARACTERISTICS

All the species and varieties except corkbark fir are found in the Pacific Coast States. Only Pacific silver fir and subalpine fir extend any distance northward into Canada. The northern Rocky Mountains have only subalpine fir and grand fir; the central Rocky Mountains have only subalpine fir: the southern Rockies and the Southwest have white fir (see fig. 1), subalpine fir, and corkbark fir.

Most of the true firs in North America have flattened needles 3/4 to 1 1/2 inches long. White fir (fig. 2) has exceptionally long needles, 1 1/2 to 3 inches, while the needles of noble fir and California and Shasta red fir are four-angled instead of flattened.

The barrel-shaped cones of all true firs are borne erect on the branches. Those of subalpine and cork-

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NOTE: This publication supersedes unnumbered publications *White Fir* and *Noble Fir*, issued in 1945.

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Figure 2.—Foliage, cone, and bark of white fir *(Abies concolor)*.

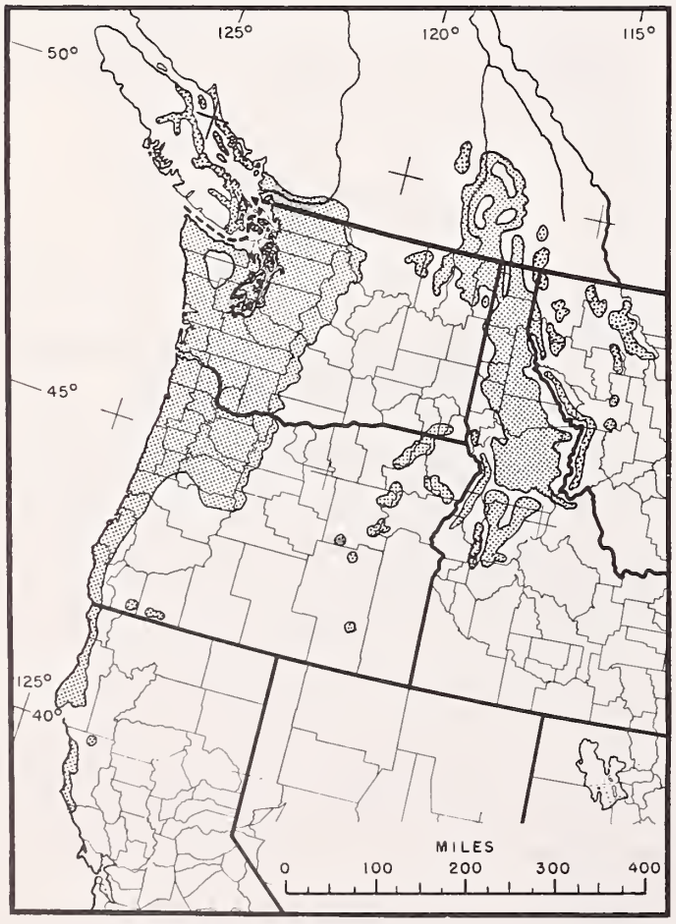

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Figure 3.—The range of grand fir *(Abies grandis)*.

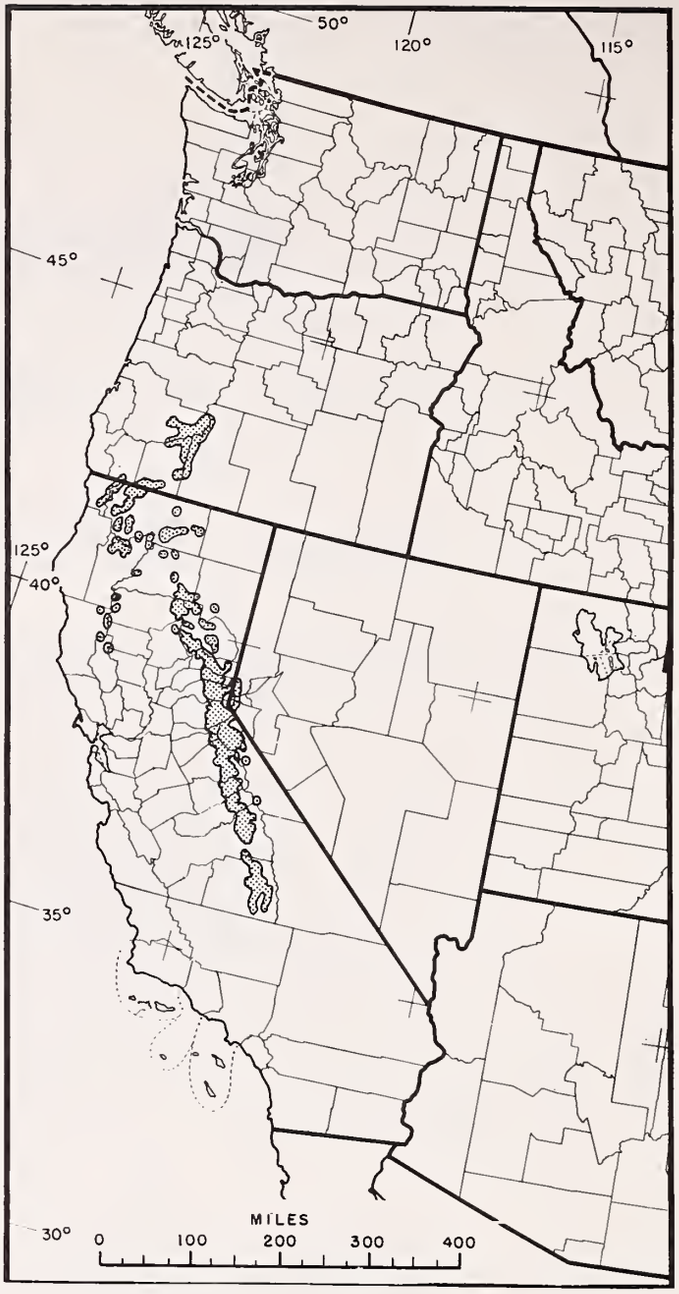

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Figure 4.—The range of California red fir *(Abies magnifica)*, including its variety Shasta red fir.

bark fir are only $2^1/_2$ to 4 inches long, while those of California and Shasta red fir are 6 to 9 inches long. The other species have cones intermediate in length. When ripe, the cones do not open; instead, the scales fall off, releasing the seed and leaving only the spikelike axes standing on the branches.

The distribution and growth characteristics vary considerably from species to species and will be discussed separately.

White fir (*Abies concolor*).—White fir grows in a variety of climates. Summers may be dry, as in the coastal States, or wet, as in parts of the Southwest. Snowfalls may be heavy, moderate, or light.

In California and Oregon, nearly pure stands of *Abies concolor* are not uncommon. This species is common in mixed stands where it often predominates. Its associates there include ponderosa pine, sugar pine, Jeffrey pine, California red fir, grand fir, Douglas-fir, and incense-cedar. In the interior, it never forms large pure stands, although it sometimes predominates in mixed stands. Its associates in the interior include Douglas-fir, ponderosa pine, aspen, blue spruce, southwestern white pine, Engelmann spruce, subalpine fir, and corkbark fir. White fir seedlings endure shade well, and this tolerance continues throughout life.

The seedlings grow slowly. After about age 30, growth usually speeds markedly. On medium-quality sites in California, trees reach heights of about 100 feet at age 100. On good quality sites in California, old dominant trees may be taller than 180 feet; heights greater than 200 feet have been measured. The record diameter at breast height (d.b.h.) is 97 inches. In the interior States, height at age 100 is often only about 40 feet, and at age 200, about 70 feet. Heights there seldom exceed 125 feet, and diameters of more than 3 feet are uncommon.

In the coastal States, white fir does not often exceed 350 years, but 500-year-old trees have been reported. Maximum ages in the interior may be near 300 years.

The fir engraver beetle sometimes causes severe damage and some mortality. Various defoliators, including the Douglas-fir tussock moth and the spruce budworm, reduce growth, cause top dieback, and kill some trees. Heart rots, butt rots, root rots, and partial cutting often result in windfall. White fir, like the other true firs, is susceptible to mistletoe infestation.

Grand fir (*Abies grandis*).—In some areas where grand fir grows (fig. 3), snowfall is heavy. In others, snowfall is insignificant.

Essentially pure stands of grand fir sometimes occur in Idaho, and it occurs mixed with many other species including Douglas-fir, western larch, western white pine, white fir, western hemlock, and western redcedar. Grand fir seedlings and trees also endure shade well.

Rooting is deep where the soil permits. Seedlings grow fairly rapidly, and in northern Idaho 100-year-old trees may be taller than 120 feet on sites of intermediate quality. The record height is 250 feet, and the record d.b.h. is 86 inches. An age of 280 years has been reported.

Where very heavy snows fall, snow breaks many trees in dense young stands, but normally this amounts only to a thinning. Spruce budworm and the fir engraver have caused widespread mortality. The balsam woolly aphid also kills grand fir in Oregon.

California red fir and Shasta red fir (*Abies magnifica*).—California red fir and Shasta red fir are very similar, and intermediate forms occur. Shasta red fir is considered a variety of the species California red fir, and both will be referred to here as California red fir.

This species grows at elevations with heavy snowpacks (fig. 4). It sometimes forms essentially pure stands, and occurs mixed with a number of other species including Jeffrey pine, western white pine, lodgepole pine, mountain hemlock, subalpine fir, white fir, ponderosa pine, and sugar pine. California red fir seedlings endure shade fairly well, but this tolerance decreases considerably with age.

Seedlings and saplings grow slowly. Large trees are taller than 150 feet and exceed 4 to 5 feet in d.b.h. The record height is 230 feet and the record d.b.h. is 96 inches. Trees over 500 years old have been reported.

The major insects killing California red fir are the fir engraver and the flatheaded and roundheaded fir borers. Dense stands of small trees frequently are thinned when numbers of trees are broken by heavy snows. Partial cutting often results in serious windthrow.

Noble fir (*Abies procera*).—Noble fir grows mainly in the superhumid climates of eastern Washington and Oregon (fig. 5), but it extends into

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Figure 5.—The range of noble fir (*Abies procera*).

areas considered merely humid. In some areas much of the precipitation falls as rain, but in most, snowfall is heavy.

Noble fir does not form large pure stands, but small pure stands are fairly common. It occurs widely in mixture with a number of other species, most commonly Douglas-fir, Pacific silver fir, western and mountain hemlocks, western white and lodgepole pines, and western redcedar. Although seedlings and saplings tolerate moderate shade, it is considered the least shade-tolerant of the white firs.

Seedlings grow slowly but later growth is rapid. Large trees are taller than 200 feet and exceed 4 feet in diameter. The largest known was 260 feet tall, and 87 inches in diameter at breast height. Large size, slight taper, and thin bark contribute to very high yields from old stands. Noble fir is considered the longest lived of the white firs, some trees exceeding 600 years.

Seedlings are drought sensitive. Insects have not been important enemies of noble fir, and it is relatively free of serious disease. Noble fir is fairly windfirm and very resistant to snow damage.

Pacific silver fir *(Abies amabilis)*.—Pacific silver fir grows in a humid or superhumid climate, with a long growing season and a short, late-summer dry season (fig. 6).

Pacific silver fir does not form pure stands of any size. It grows mixed with a number of other species including western hemlock, Sitka spruce, Douglas-fir, and mountain hemlock. From seedling to maturity, Pacific silver fir is probably the most shade-tolerant of the western firs.

The root system of Pacific silver fir is shallow. Seedlings grow very slowly, but eventually some trees stand 200 feet tall with diameters of more than 6 feet. The largest known tree was 245 feet tall and 101 inches in d.b.h. The greatest known age is 540 years.

The balsam woolly aphid causes serious mortality. Other insects killing Pacific silver fir are the flatheaded fir borer, the silver fir beetle, and the fir root bark beetle. The species is susceptible to windthrow.

Subalpine fir and corkbark fir *(Abies lasiocarpa)*.—Subalpine fir, with thin, smooth bark, and corkbark fir, with thick, soft, wrinkled bark, are ecologically similar. Both belong to one species, *Abies lasiocarpa*. The crowns of mature trees are distinctive among western firs—narrow and spirelike.

This species has a much greater range than any other western fir (fig. 7). Subalpine fir occurs extensively from the Yukon Territory to the Kaibab Plateau in northern Arizona. Corkbark fir is a tree of New Mexico, Arizona, and southwestern Colorado. Trees intermediate between the two varieties

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Figure 6.—The range of Pacific silver fir *(Abies amabilis)*.

are common in southwestern Colorado. *A. lasiocarpa* is primarily a subalpine species, extending to timberline. Growing seasons are short and cool; winters are long and snowy, and over most of its range cold or very cold.

Pure stands of *A. lasiocarpa* are uncommon, but it is a major component of three extensive forest types: the Engelmann spruce–subalpine fir type, the white spruce–subalpine fir type (in western Canada), and the mountain hemlock–subalpine fir type. It occurs mixed with a number of other species including Douglas-fir, aspen, lodgepole pine, white fir, western hemlock, and Pacific silver fir.

Seedlings endure shade very well, this tolerance persisting throughout life. They grow very slowly, and although growth speeds up as the tree approaches the sapling stage, it is never rapid. Mature trees are typically 60 to 100 feet tall and 12 to 24 inches in diameter. Trees larger than 30 inches in diameter and 130 feet tall are exceptional. The record corkbark fir is 45 inches d.b.h. Trees often live for more than 250 years.

Serious mortality is sometimes caused by the spruce budworm, the black-headed budworm, the

balsam woolly aphid, and the western balsam bark beetle. The balsam fir rust fungus kills many trees.

Figure 7.—The range of subalpine fir *(Abies lasiocarpa)*, including its variety corkbark fir.

SUPPLY [3]

The total stand of sawtimber-size "white fir" in the western United States is estimated to be 222 billion board feet.[4] By regions, about 46 percent of the total stand is in the Pacific Northwest, 34 percent in the Pacific Southwest, 13 percent in the northern Rocky Mountains, and 7 percent in the southern Rocky Mountains. By States about 34 percent of the total stand is in California, 25 percent in Washington, and 21 percent in Oregon.

[3] All acreage and volume figures are based on the most current estimates as provided by the Forest Survey Units at the Pacific Northwest, the Pacific Southwest, and the Intermountain Forest and Range Experiment Stations.

[4] Volume of 9.0 inch and larger diameter trees by International 1/4-inch Log Rule.

PRODUCTION

The production of "white fir" lumber has fluctuated widely, but generally increased from 1905 to the mid-1960's (fig. 8). Production rose spectacularly from approximately 121 million board feet in 1940 to a record of 2,838 million board feet in 1959. Production since 1959 has been lower and variable. About 80 percent of the total lumber production in 1964 came from California, Oregon, Washington, and Alaska. The average production of lumber for the period 1957 through 1966 inclusive was 2,348 million board feet per year, with an increasing volume being used for veneer. The net annual cut of "white fir" from growing stock during 1962 was estimated at about 405 million cubic feet.

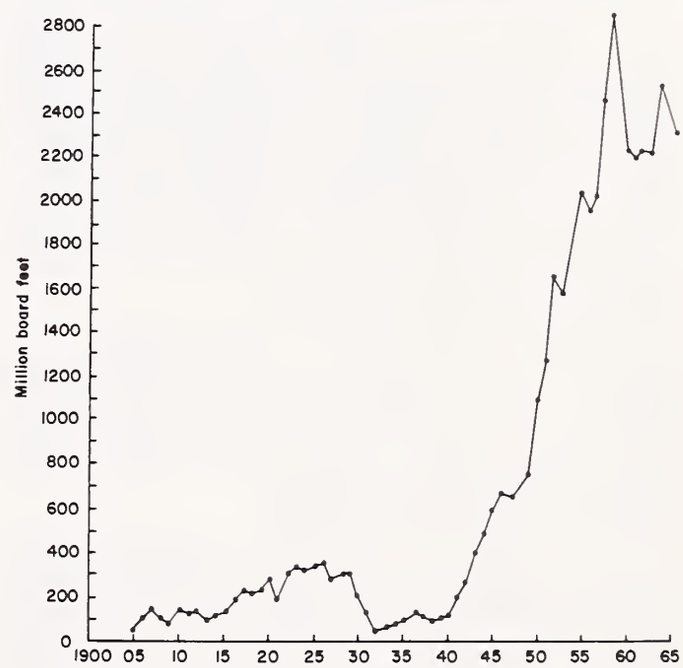

Figure 8.—Lumber production of "white fir", 1905–66.

CHARACTERISTICS AND PROPERTIES

The wood of the western true firs generally referred to as "white fir" in the lumber trade is nearly white to reddish brown, with little or no difference between the sapwood and heartwood. The annual rings show a marked difference in color between the summerwood and the springwood of the succeeding year. The transition from springwood to summerwood is gradual. The wood has a medium to somewhat coarse texture, has no characteristic taste or odor when dried, and has no normal resin canals.

It appears similar to that of western hemlock except the transition from the springwood is more abrupt and the springwood is generally coarser textured.

The wood is generally straight grained, relatively easy to work, and stays in place when properly dried. It is one of the lighter important commercial woods of the United States, having an average specific gravity of 0.35 based on ovendry weight and green volume. The weight of "white fir," excluding subalpine fir, averages 27 pounds per cubic foot at 12 percent moisture content; subalpine fir weighs 23 pounds. The wood is rated moderately low in beam strength, ability to resist shock, and in nail withdrawal resistance. It is rated moderately stiff and moderately strong in post strength. The lumber is commercially kiln dried green from the saw. Wetwood, or "water pocketing" occasionally causes problems that require special handling.

In paint-holding properties, "white fir" is classed with ponderosa pine and western hemlock—below the white pines, cedars, redwood, and cypress, but above Douglas-fir and southern yellow pine. "White fir," together with western redcedar and redwood, is among the woods that glue easily under a wide range of conditions. The heartwood is not durable when used under conditions favorable to decay. In this, it ranks with the spruces and the hemlocks. As with practically all other species, the sapwood lacks durability. The wood is considered difficult to penetrate with a preservative.

The lumber from some of the "white firs," especially from subalpine and corkbark firs, is quite likely to contain small knots formed by numerous small limbs, which persist for a long time. Consequently, these species yield only minor amounts of select grade lumber.

All the "white firs" are pulped by any process as easily as spruce, and, except for red fir, compare favorably in quality. Red fir yields darker mechanical pulp, and its sulfite and sulfate pulps are more difficult to bleach than those from spruce. The sulfite pulp is suitable for the manufacture of newsprint, light-colored wrapping, book, and other high-grade printing papers. The sulfate pulp is suitable for high-grade kraft wrapping papers and fiberboard. The groundwood pulp is suitable for all uses requiring this type of pulp.

PRINCIPAL USES

Today, the "white firs" are primarily used for lumber, pulpwood, and plywood. Most of the lumber is used for construction. During 1960, 2,240 million board feet of lumber was produced, and only 367 million was used in manufacture by industry. Construction uses for the lumber include framing, sheathing, subflooring, concrete forms, roof decking, planking, posts, stringers and timbers, siding, interior trim and millwork, paneling, sash and doors, and flooring. Industrial uses include box shook, industrial shook and crating, casket shook, pallet stock, car bracing and dunnage, and laminated wood products.

The wood is light in weight and color, easy to work, and free from odor, pitch, and stain. It is especially suitable for fresh fruit and vegetable containers. The pulp is manufactured mostly into various grades of printing paper and wrapping paper.

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